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FOREST PEST MANAGEMENT

Effects of Application Rate and Timing of Ethephon Treatments on Abscission of Ponderosa Pine Dwarf Mistletoe Two Years Following Treatment

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ABSTRACT

Evaluation of field tests of the plant growth regulator, ethephon, has shown that significant abscission of dwarf mistletoe shoots occurs within a few weeks after application. Tests conducted in the Black Forest north of Colorado Springs, Colorado in 1988 on ponderosa pine dwarf mistletoe showed abscission rates of 73 to 98 percent with mid-June, mid-July and mid-August applications of the chemical at rates of 2200 and 2700 ppm of ethephon in water with a spreader-sticker.

Examination of trees two years following treatment showed some development of immature shoots on all treatments, but insignificant numbers of mature shoots with fruits on all infections including controls (non-chemically treated trees). The reduction in numbers of infections with shoots observed in the controls is attributed to a combination of natural control agents including, drought, branch mortality, and insects. Observations are planned for several more years to determine when mature shoots will develop on ethephon-treated trees.

INTRODUCTION

Interest in the plant growth regulator ethephon (2-chloroethylphosphonic acid) causing the abscission of dwarf mistletoe shoots has stimulated field tests to evaluate it's effectiveness on several species of dwarf mistletoes thoughout the western United States (see references). In the Rocky Mountain Region, tests on ponderosa pine dwarf mistletoe (Arceuthobium vaginatum) were begun in 1988. During June, July and August 1988, ethephon was applied by hydraulic sprayer at rates of 0 (control), 2200 and 2700 ppm with nonionic surfactant (Ortho X-77 spreader) in water to ponderosa pine infected with dwarf mistletoe in the Black Forest north of Colorado Springs, Colorado. Details of the study site and methods used for the study are contained in the report by Johnson, Hildebrand and Hawksworth, 1989.

This report summarizes data collected since the inception of the study in 1988.

METHODS AND MATERIALS

Direct observation of previously tagged infections on trees was made on July 5, 1990. The presence of shoots and those with fruits was recorded. A photographic record was also made of selected individual infections. Results for the two application rates were compared to the controls and to each other, and tested for statistical significance using the chi-square test.

RESULTS AND DISCUSSION

Data for each application date within treatments (June, July and August) were combined since there was little difference in results between treatment dates. Since seed dispersal commenced by early August, treatment by mid-July was effective in limiting spread of the disease the same year. Loss of infected branches to mortality caused by breakage, girdling by rodents, and other natural agents was observed since the inception of the study and amounted to 20 percent (Table 1). An adjustment of the data base was made accordingly.

One month after treatment in 1988, frequency of infections with shoots was 94 percent in the controls, and significantly less in ethephon-treated infections. Frequencies ranged from 44 to 28 percent for infections treated with 2200 and 2700 ppm ethephon, respectively (Table 2). Results were significantly different between the two application rates one month after treatment. Only one infection had fruits out of the 270 tagged for observation. Development of small immature shoots was noted in all treatments by August.

Table 1. Numbers of dwarf mistletoe infection sites remaining on live ponderosa pine branches treated with ethephon and observed over a two-year period, Black Forest, Colorado.

Treatment	Year and Number of Live Branches Remaining		
	1988	1989	1990
Control 0 ppm	90	81	71
Ethephon 2200 ppm	90	78	72
Ethephon 2700 ppm	90	81	72
Totals	270	240	215

Table 2. Percent changes in dwarf mistletoe infections with shoots and with fruits observed over a two-year period on ponderosa pines treated with ethephon, Black Forest, Colorado.

Treatment	Year and Percent of Infections with Shoots and with Fruits				
	1988	1989		1990	
	Shoots	Shoots	Fruits	Shoots	Fruits
Control 0 ppm	94.0	80.2	44.4	16.9	0
Ethephon 2200 ppm	44.4*	66.6*	6.4*	16.7 ns	1.4 ns
Ethephon 2700 ppm	27.8*	51.8*	1.2*	15.3 ns	2.8 ns

Treatment results compared with controls: * = $P < 0.05$; ns = not significant.

One year following treatment in 1989, frequency of infections with shoots was 80 percent in the controls, and significantly less for ethephon-treated infections: 52-67 percent. Frequency of infections with fruits was 44 percent in the controls and significantly less in ethephon-treated infections: 1 to 6 percent (Table 2). Results were not significantly different between the two ethephon application rates in 1989.

In 1989 (Johnson, Hildebrand, and Hawksworth 1989; Johnson and Hildebrand 1989), natural abscission and insect activity caused the reduction in numbers of shoots observed in the controls (Plate 1). In 1990, two years after treatment, dwarf mistletoe shoot development was depressed uniformly over all treatments apparently due to drought and there was no significant difference in numbers of infections with shoots or with fruits for any treatment (Table 2 and Plate 1). Out of a total of 215 infection sites, only 3 had fruits.

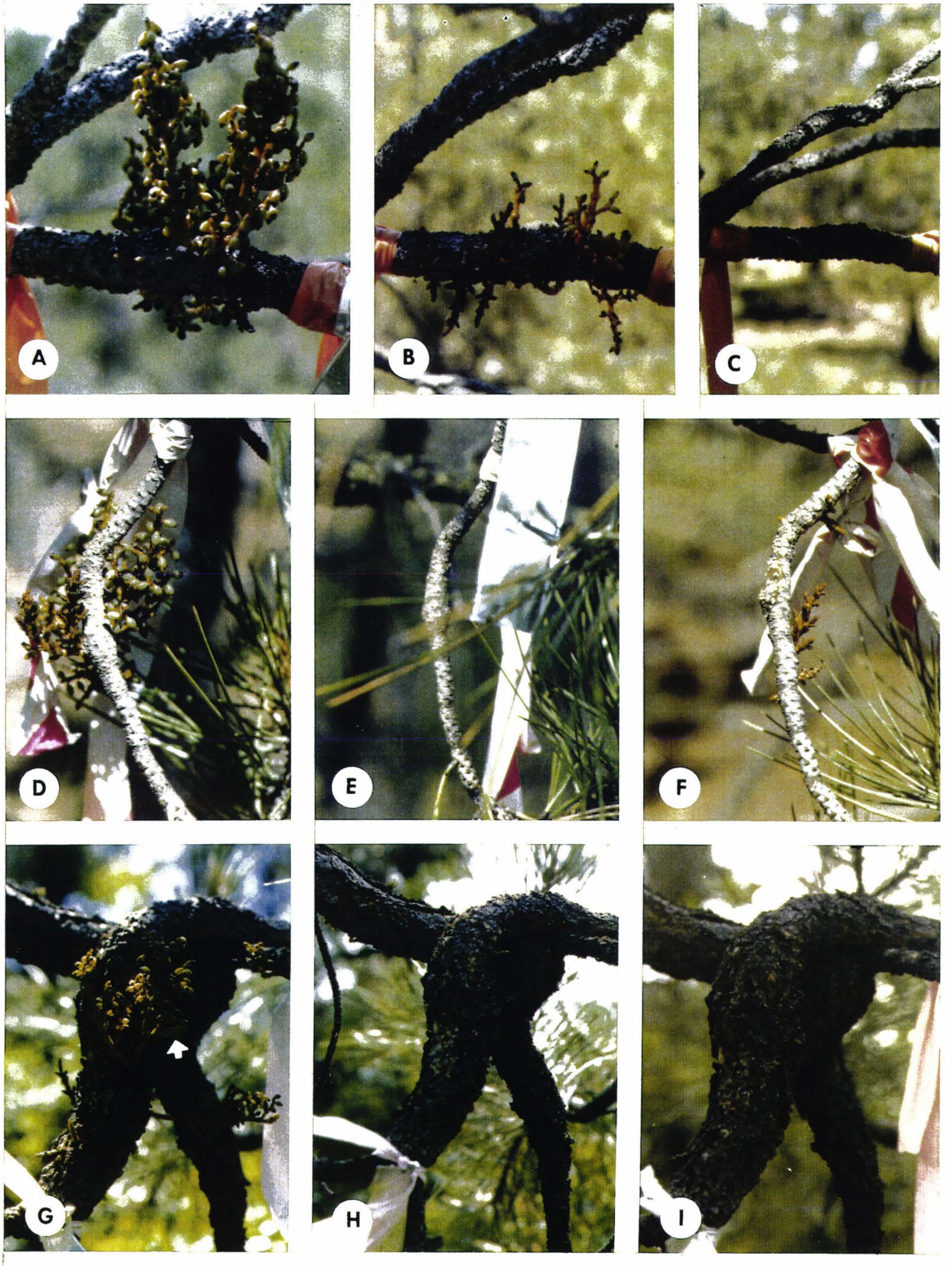
Observations are planned for several more years to determine when mature shoots will develop on ethephon-treated trees.

PLATE 1. Ponderosa pine dwarf mistletoe infections before, one year, and two years after treatment with water and ethephon, Black Forest, Colorado, 1988-90.

1st Row: Branch infection caused by ponderosa pine dwarf mistletoe before (a), one year (b), and two years (c) after treatment with water and spreader-sticker only. Note natural abscission of shoots in (c).

2nd Row: Branch infection before (d), one year (e), and two years (f) after treatment with 2200 ppm ethephon with spreader-sticker. Some development of immature shoots present in (f).

3rd Row: Branch infection before (g), one year (h), and two years (i) after treatment with 2700 ppm ethephon and spreader-sticker. Larva of the hairstreak butterfly, Mitoura sp., feeding on shoots in (g) (arrow).


A
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